Contribution of Physical Education and Recess towards the overall Physical Activity of 8-11 year old children.

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Original

CONTRIBUCIÓN DE LA EDUCACIÓN FÍSICA Y EL RECREO HACIA LA ACTIVIDAD FÍSICA GENERAL DE LOS NIÑOS DE 8-11 AÑOS.

CONTRIBUTION OF PHYSICAL EDUCATION AND RECESS TOWARDS THE OVERALL PHYSICAL ACTIVITY OF 8-11 YEAR OLD CHILDREN.

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RESUMEN

Objetivos: Los objetivos de este estudio fueron medir objetivamente la actividad física (PA) en una muestra de 8-11 años y establecer la proporción de estos niños que cumplen con las pautas actuales de PA para determinar en qué medida PE y el recreo (tiempos de descanso y almuerzo) contribuye al AP general de los niños, con un enfoque en la edad, el sexo y la composición corporal en Irlanda del Norte (NI).

Material y métodos: Se realizaron mediciones antropométricas y de acelerómetro en 61 niños (9,3 + 1,0 años), incluidos 24 niños y 37 niñas de 8 clases seleccionadas al azar. En promedio, los niños acumularon 4.8 + 0.6 días con datos de acelerómetro válidos (> 10 horas) incluyendo 3.1 + 0.4 días de semana y 1.7 + 0.5 días de fin de semana. Los datos para este estudio se recolectaron entre abril y junio de 2015.

Resultados: Los niños acumularon 63.3 ± 18.2 minutos en MVPA (diariamente) comparado con 61.3 + 23.4 minutos (día PE) y 63.0 + 22.5 minutos (día no PE). Esto indicaría que los niños no fueron significativamente (P> 0.05) más activos en días de PE en comparación con los días sin PE. Curiosamente, la PE solo contribuyó al 6.4% del MVPA general de los niños, mientras que el tiempo de descanso (receso de la mañana) y el almuerzo (receso de la tarde) contribuyeron al 18.7% y 18.4% respectivamente. Esto indicaría que hubo una diferencia significativa (P <0.05) en el porcentaje de tiempo pasado en MVPA en el que participaron todos los niños durante las clases de EF en comparación con el tiempo de descanso y el tiempo de almuerzo MVPA.

Discusión/ Conclusiones: Los resultados indican que más de la mitad (54.1%) de los niños están alcanzando las pautas diarias de> 60 minutos de MVPA. Además, la educación física y el recreo (tiempo de descanso y almuerzo) contribuyeron a casi la mitad (43.5%) del MVPA total de los niños. En general, los niños pasaron una mayor proporción del tiempo en MVPA durante las clases programadas de educación física, el tiempo de descanso (receso de la mañana) y el almuerzo (recreo) en comparación con las niñas en este estudio. Parecería que las clases de Educación Física y el recreo (descanso y almuerzo) proporcionan ocasiones importantes para que los niños participen en AP. Sin embargo, los niños son más activos durante el recreo y el almuerzo que durante las clases programadas de EF en este estudio. Esto demuestra claramente que el entorno escolar es una opción viable para la prestación de AP para muchos de nuestros niños.

Palabras clave: Niños, Actividad Física, Educación Física y Receso.

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ABSTRACT

Objectives: The purposes of this study were to objectively measure physical activity (PA) in a sample of 8-11 year olds and to establish the proportion of these children who fulfil current PA guidelines to determine to what extent PE and recess (break and lunch times) contributes to children's overall PA, with a focus on age, gender and body composition within Northern Ireland (NI).

Methods: Anthropometric and accelerometer measurements were conducted on 61 children (9.3±1.0 years) including 24 boys and 37 girls from 8 randomly selected classes. On average, children accumulated 4.8±0.6 days with valid accelerometer data (>10 hours) including 3.1±0.4 week days and 1.7±0.5 weekend days. Data for this study were collected between April to June 2015.

Results: Children accumulated 63.3±18.2 minutes in MVPA (daily) compared to 61.3±23.4 minutes (PE day) and 63.0±22.5 minutes (Non-PE day). This would indicate that children were not significantly ($P \geq 0.05$) more active on PE days compared to Non-PE days. Interestingly, PE only contributed to 6.4% of children's overall MVPA, while break time (morning recess) and lunchtime (afternoon recess) contributed to 18.7% and 18.4% respectively. This would indicate, there was a significant difference ($P \leq 0.05$) in the percentage of time spent in MVPA that all children participated in during PE classes compared to both break time and lunch time MVPA.

Discussion/Conclusions: Results indicate that more than half (54.1%) of children are attaining the daily guidelines of ≥ 60 minutes of MVPA. Moreover, PE and recess (break and lunch time) contributed to almost half (43.5%) of children's total MVPA. Overall, the boys spent a higher proportion of the time in MVPA during scheduled PE classes, break time (morning recess) and lunchtime (recess) in comparison to the girls in this study. It would appear that PE lessons and recess (break and lunch time) provide important occasions for children to be engaged in PA. However, children are more active at break time and lunch time than they are during scheduled PE classes in this study. This clearly demonstrates that the school setting is a viable option for the delivering PA for many of our children.

Keywords: Children, Physical Activity, Physical Education and Recess.

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INTRODUCCIÓN

Over the last decade, it is widely accepted that physical activity (PA) is an essential element of a healthy lifestyle (Strong et al., 2005). Research advocates that increases in PA have the potential to improve the nation's physical and psychological health and well-being, in addition to decreasing mortality and morbidity as well as developing and extending life expectancy (Department of Health, 2011). Therefore, the development of a healthy PA pattern in childhood is central for a healthy lifestyle in later life (Cumming and Riddoch, 2009), thereby encouraging both sufficient PA and limiting sedentary behaviour (SB) as noted by Van Kann et al (2016). Despite the increasing recognition of the health benefits associated with regular PA, research by both Breslin et al (2012) and Griffith et al (2013) have advised that the majority of children and young people are failing to meet the current guidelines of $\geq$ 60 minutes moderate-to-vigorous intensity physical activity (MVPA) per day (Department of Health, 2011). Evidence suggests that PA levels appear to decline with age, with older children and adolescents accruing less daily MVPA (Dumith et al, 2011), the overweight are generally less active than the lean (Ness, 2007), whilst boys are typically more active than girls (Riddoch et al, 2003). More recently, it would appear that children in NI are less active than their peers across the UK (Griffiths et al, 2013) and the Republic of Ireland (Currie et al, 2009). Unsurprisingly, in 2010, the World Health Organisation (WHO) identified childhood as a significant time to encourage and develop active lifestyle habits.

For a growing number of children, the school environment offers the prospect for delivering health-promoting PA (Nettlefold et al, 2011). Schools provide a variety of circumstances for children to participate in PA via PE lessons, recess and extracurricular activities (Verstraete et al, 2006). Both PE and recess provide key times for children to engage in PA (Ridgers et al, 2005). As children spend 40-45% of their day in school (Fox and Harris, 2003), research by Pate and O'Neill (2008) suggest that the school setting can therefore play a crucial role in delivering and promoting PA and healthy, active lifestyles (Cale and Harris, 2009) in addition to encourage pupils to develop physical competencies and positive attitudes to PA (Department of Education, 2013). PE has been the long-established setting for promoting PA during the school day (Ridgers et al, 2007). While, PE's contribution to health-enhancing behaviours during childhood and in later life has long been acknowledged (Bailey and Kirk, 2009). Yet, PE is suffering from decreasing curriculum time and low subject status compared with seemingly superior academic subjects (Hardman and Greene, 2011). Recess amounts to almost a quarter of the typical primary school day (Ridgers et al, 2005) and therefore offers a viable and complementary alternative setting to PE, which provides children with everyday opportunities to participate in PA (Ridgers et al, 2006a).

Even though PA during PE appears to be relatively low (Fairclough and Stratton, 2006), recess MVPA is also lower than recommended (Ridgers et al, 2005). Yet, research has acknowledged very little is understood about the impact of PA during PE (Meyer et al, 2011) or PA during recess (Nettlefold et al, 2011) to overall PA. Although, the close relationship between PE, recess and PA is hardly a new concept. It is therefore worth considering how PE and recess (break and lunch) contributes to pupils overall PA.

This proposal hypothesizes that the PA during PE and PA during recess both make a significant contribution to overall PA. The rationale for this proposed study is to examine PA during PE lessons and recess (break and lunch) in a sample of 8-11-year-old Northern Irish children, to determine the percentage of these children who fulfil current PA guidelines and to conclude to what extent PE and recess (break and lunch) influences overall PA, with a focus on age, gender and body composition within Northern Ireland (NI).

MATERIAL Y MÉTODOS

Participants

Four primary schools in the County Down area of Northern Ireland were invited to participate in the study. Ethical approval was granted from the institutional ethical review committee. School and parental consent and child assent was provided. Data included in this study was derived from a sample of 92 children 8-11 year olds (39 boys and 53 girls). Following data cleansing, the final sample thus comprised 61 children 8-11 year olds (24 boys and 37 girls) from 8 randomly selected classes. The

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study was carried out between April and June 2015, in the final term of the school year in Northern Ireland.

Measures

All anthropometric measures will be undertaken in schools by trained investigators. Height and weight were recorded to the nearest 0.1cm and 0.1kg using a portable stadiometer (SECA 213, UK) calibrated electronic scales (SECA 815, UK) with children wearing their school PE uniform (shorts and t-shirt) but removing shoes. Body mass index (BMI) was calculated as kg/m². BMI categories were defined using the age and gender specific cut-off points for BMI as published by the IOTF (Cole et al, 2000). Waist and hip circumference was measured with an ergonomic circumference measuring tape (SECA 201, UK). The average of two measurements for both height, weight and waist and hip circumference was retained. Physical Activity (PA) was measured with tri-axial accelerometers (ActiGraph GT3X, USA) as accelerometry is universally accepted as a reliable, valid and objective method for assessing PA and sedentary behaviour (SB) in a variety of groups from children to older adults (Ekelund et al., 2011; Robusto and Trost, 2012; Cain et al., 2013).

Protocols

Following ethical approval being granted at institutional level, school approval, parental consent and student assent were obtained from all participants. Parents and children were given an information pack which consisted of an information sheet, detailed activity monitor instructions and activity monitor diary to record times for wearing and removing the activity monitor. For each of the eight classes, data collection was carried out over a two week period. In the first week, height, weight and waist and hip circumference measurements were taken during a regularly scheduled PE class. BMI was also calculated using the age and gender specific cut-off points (Cole et al, 2000). In the second week, students' objective PA levels were recorded using a tri-axial accelerometer (ActiGraph GT3X, USA). These were distributed to participants in school and instructions on correct wear were provided. Accelerometers were attached to an elastic belt and worn at the right hip for a minimum of 4 days (including the weekend). A minimum of four measurement days has been recommended to reach a sufficient reliability (Trost et al., 2000). The sampling epoch was set at 1 second to capture as much variation in activity as possible (Corden and Ekelund, 2008). This short epoch captures significantly more time spent at MVPA than when using 60-second epochs (Nilsson et al, 2002; Rowlands and Eston, 2007). Participants were asked to wear the accelerometer during waking hours for a minimum of 4 days (Meyer et al, 2011) and to only remove when sleeping, bathing or participation in water sports (Mattocks et al, 2007). Participants were also given a log sheet and asked to record accelerometer on and off times each day (Nettlefold et al, 2011) including reasons for removal of accelerometers e.g. showering or swimming (Griffiths et al, 2013). Accelerometers were distributed on a Friday morning (9.00am) and collected on a Thursday morning (9.00am) (Nettlefold et al, 2011). The minimum wear-time for inclusion was $\geq$10 hours of registered time for $\geq$3 days (Mattocks et al, 2008). Sustained $\geq$15 minute periods of consecutive zero counts were removed from the analysis of daily wear-time (Meyer et al, 2011). As large individual differences exist in counts at different activity intensities (Rowlands and Eston, 2007). Therefore age-specific cut points were utilised to classify PA intensity. Evenson et al (2008) PA intensity cut points were applied to the analysis. Trost el al (2011) recommend that researchers use the Evenson ActiGraph cut points to estimate time spent in sedentary, light-, moderate-, and vigorous-intensity activity in children and adolescents. Where a sedentary threshold of $\leq$100 was adopted to denote sedentary (SED), $\geq$101 for light physical activity (LPA), $\geq$2296 moderate physical activity (MPA) and $\geq$4012 vigorous physical activity (VPA). Time spent per valid day in SED, LPA, MPA and VPA were calculated for each individual.

Statistical Analysis

Initially validation of PA data (i.e. checking for invalid data) was carried out using ActiLife 6 data analysis software (ActiGraph Corp, Florida, USA). Participants anthropometric data as well as PA data was calculated and analysed further using Microsoft Excel (Microsoft Excel 2007, Microsoft Corporation, USA). More detailed statistical analysis was undertaken analysed using the Statistical Package for

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Social Sciences (SPSS V20.0, SPSS Inc, Chicago, USA) for quantitative data. Whilst data collected from the accelerometers will be also be analysed using Microsoft Excel and SPSS, and the significance level was set at $P \leq 0.05$. Data are shown as means ± standard deviation, unless stated differently. Independent Samples T-Tests were conducted to assess gender differences between the anthropometric data and PA data of the boys and girls. Paired Samples T-tests was utilised to examine differences between time spent in MVPA on a PE day, Non-PE day in addition to time spent in MVPA during PE and recess (break and lunch time). Univariate analysis of variance were calculated for the following variables: gender and MVPA minutes and percentage across daily, PE days and Non-PE days as well as scheduled PE classes, break time and lunch time. Scatter graphs and correlations (Pearson) were employed to assess BMI SDS and WHR and time spent in MVPA.

RESULTADOS

Of the 91 children from the 8 participating classes, 31 (34%) children could not be included for analysis due to incomplete anthropometric data or insufficient accelerometer data. Therefore, data of 61 children (24 boys and 37 girls) aged 9.3 ± 1.0 years were included into analysis. On average, children had 4.8 ± 0.6 days with valid accelerometer data including 3.1 ± 0.4 week days and 1.7 ± 0.5 weekend days. A total of 122 days with PE and 122 days without PE were included in the analysis.

The mean (±SD) time children spent in MVPA per day equated to 63.3 ± 18.2 minutes (Figure 1). While the mean time spent in MVPA also varied on a PE day (61.3 ± 23.4 minutes) and Non-PE day (63.0 ± 22.5 minutes). Overall, boys spent more time in MVPA on a daily basis as well as PE and Non-PE days compared to the girls (Figure 1). Results would indicate that children were generally less active on days with PE compared with days without PE, however, girls were more active on a PE day compared to a Non-PE day.

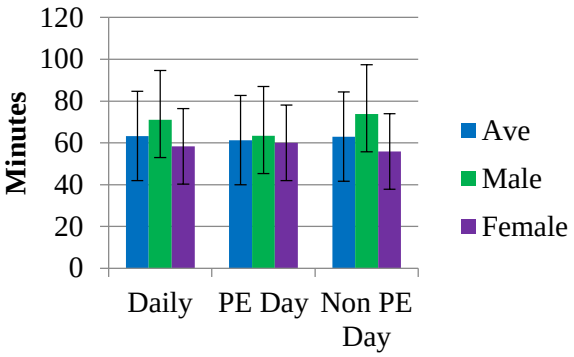

Figure 1. Mean (+SD) Time Spent in MVPA by Day

Data demonstrates that boys spent less time in SED and more time in PA than the girls and the overall mean (±SD) for this study (Table 1). Findings clearly indicate that there is a significant difference ($P \leq 0.05$*) by between genders with reference to MPA, VPA and MVPA in this study.

Table 1. Mean (±SD) Daily Physical Activity Data

	Mean (N=61)	**Male** (N=24)	**Female** (N=37)	**P-Value**
SED Mins	605.2 ± 65.0	600.2 ± 65.1	608.5 ± 65.7	0.63
SED %	77.3 ± 4.2	76.0 ± 5.0	78.2 ± 3.4	0.07
LPA Mins	113.7 ± 19.4	117.5 ± 22.0	111.3 ± 17.3	0.26
LPA %	14.6 ± 2.5	15.0 ± 3.1	14.3 ± 2.0	0.36
MPA Mins	31.4 ± 8.7	35.3 ± 9.2	28.9 ± 7.4	0.01*
MPA %	4.0 ± 1.1	4.5 ± 1.2	3.7 ± 0.9	0.01*
VPA Mins	31.9 ± 11.3	35.7 ± 14.2	29.4 ± 8.3	0.05*
VPA %	4.1 ± 1.5	4.6 ± 1.9	3.8 ± 1.1	0.01*
MVPA Mins	63.3 ± 18.2	71.1 ± 21.3	58.3 ± 14.0	0.01*
MVPA %	8.1 ± 2.4	9.0 ± 2.8	7.5 ± 1.9	0.01*

There is a significant difference ($P \leq 0.05$*) between gender and mean time spent in MVPA on a daily basis and on a Non-PE day. Even though boys spent more time in MVPA on a daily basis and both a PE day and a Non-PE day. Results indicate that there was no significant difference ($P \geq 0.05$) in the mean (±SD) time spent in MVPA on a PE days between the boys and girls in this study (Table 2).

Table 2. Mean (±SD) Time Spent in MVPA by Day

	Mean (N=61)	**Male** (N=24)	**Female** (N=37)	**P-Value**

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Daily	63.3 ± 18.2	71.1 ± 21.3	58.3 ± 14.0	0.01*
PE Day	61.3 ± 23.4	63.4 ± 22.7	60.0 ± 24.1	0.58
Non-PE Day	63.0 ± 22.5	73.8 ± 26.8	55.9 ± 16.1	0.01*

On average, over half (54.1%) of participants meet the PA Guidelines of 60 minutes of MVPA per day across the study, with similar figures for PE days (49.2%) and Non-PE days (54.1% on). Results indicate that 66.7% of boys (N=16) and 45.9% of girls (N= 17) meet the current PA guidelines of 60 minutes of MVPA per day. Within this study there is a significant difference (P ≤ 0.05*) between genders with reference to time spent in MVPA per day and on Non-PE days.

Overall, the boys spent a higher proportion of time in MVPA across the study as well as PE and Non-PE days compared to the girls (Figure 2). Similarly, the

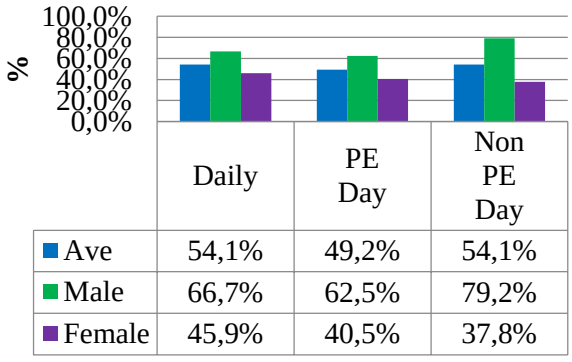

Figure 2. Mean Percentage of Children Meeting 60 Minutes of MVPA

boys spent a higher percentage of the time in MVPA within scheduled PE classes, break time (morning recess) and lunch time (recess) compared to the girls in this study (Figure 3). Results suggest that during scheduled PE classes, children accumulated around one third (6.4%) of the MVPA compared to MVPA accumulated during both break time (18.7%) and lunch time (18.4%) respectively. It would appear that children are more active at break time and lunch time than they are during scheduled PE classes.

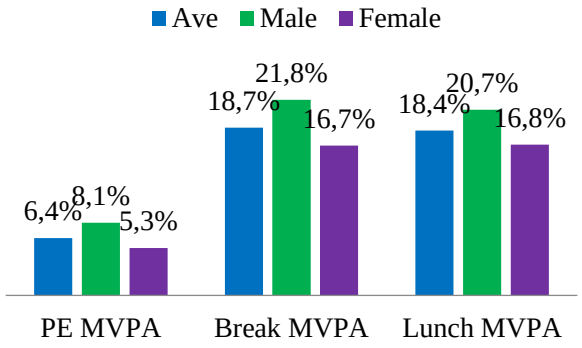

Figure 3. Mean Percentage of PE, Break and Lunch spent in MVPA

There is a significant difference (P ≤ 0.05*) between gender and MVPA % during scheduled break time, however, there was no significant difference between gender and MVPA % during PE classes and lunch time (Table 3).

Table 3. Mean (±SD) Percentage of PE, Break and Lunch spent in MVPA

	Mean (N=61)	**Male** (N=24)	**Female** (N=37)	**P-Value**
PE MVPA %	6.4 ± 6.5	8.1 ± 6.1	5.3 ± 6.6	0.10
Break Time MVPA %	18.7 ± 9.3	21.8 ± 9.6	16.7 ± 8.6	0.04*
Lunch Time MVPA %	18.4 ± 10.3	20.7 ± 10.6	16.8 ± 10.0	0.16

Results suggest, there is no significant difference (P ≥ 0.05) in the mean (±SD) percentage spent in MVPA that all children participated in during break time compared to lunch time (Table 4). However, there was a significant difference (P ≤ 0.05*) in the mean (±SD) percentage spent in MVPA that all children participated in during PE classes compared to both break time and lunch time MVPA (Table 5).

This suggests that PE does not make an important contribution to children's MVPA in this study, while MVPA during break and lunch time is significant.

Table 4. Comparison of Mean (±SD) % Spent in MVPA during Break and Lunch

	Lunch MVPA %
Break MVPA %	P = 0.77

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Table 5. Comparison of Mean (±SD) % Spent in MVPA during PE, Break and Lunch

	Break MVPA %	Lunch MVPA %
PE MVPA %	P = 0.00**	P = 0.00**

With reference to age and body composition, results concluded that correlations were weak and that there was little variance between the variables. A larger sample should be utilised to employ inferential statistics to determine the influence of age and body composition to be explored conclusively.

DISCUSIÓN

Overall, boys spent less time in SED and more time in MVPA across this study compared to girls. The average time spent in MVPA was 63.3 ± 18.2 minutes, which is consistent with other accelerometer based studies (Meyer et al, 2011; Griffiths et al, 2013). Over half (54.1%) of children including 66.7% of boys (N=16) and 45.9% of girls (N= 17) met the PA guidelines of ≥ 60 minutes of MVPA per day, which is comparable with the findings from the Millennium Cohort Study (Griffiths et al, 2013) on 7-8 year olds, which reported that only 51% met CMO guidelines, with girls (38%) less active than boys (63%). However, this falls short of the reported 69% of 9-10-year-old children whom were sufficiently active by Steele et al (2009) and the 76% of boys and 53% of girls whom accumulated ≥ 60 min of MVPA per day in a similar study of 9–10-year-old UK children utilising identical intensity thresholds (Owen et al, 2009). More worryingly, is that within this study almost one third (33.3%) of boys and over half (54.1%) of girls are not meeting the PA guidelines of ≥ 60 minutes of MVPA per day.

Within this study PE classes were scheduled for 30 minutes, which were comparable to the scheduled 30-45 minute per PE class utilised by Nettlefold et al (2011). However, they were shorter than the 45-50 minute PE classes (Meyer et al, 2011) and 50 minute PE classes employed by Ruch et al, 2012. Research by Ridgers et al (2005) proposes that for PE to significantly influence the accumulation of PA, it has been recommended that children are active for at least 50% of class time. Alarmingly, within this study children spent insignificant proportions of time in MVPA during PE (6.4%). Which is lower than the 11-13% reported by Nettlefold et al (2011) and well below the 10-20% reported by Mallam et al (2003) and substantially lower than previous studies that reported 37-40% of PE class spent in MVPA (Wickle and Eisenmann, 2007; Meyer et al, 2011). Alarmingly, not one child in the study met the recommended guidelines of 50% of PE spent in MVPA which is considerable less than the 5% of boys and girls that met these guidelines in research by Nettlefold et al (2011). Findings and observations within this study suggest that PA in PE may be lower in this study due to the modest amount of time allocated to PE compared to time allocated to PE in Nettlefold et al (2011), Meyer et al, (2011) and Ruch et al (2012). Research proposes that seasonal variation (Mattocks, 2007), the type of activity and content of the PE lesson (Meyer et al, 2011), lesson planning and delivery (Fairclough and Stratton, 2004) and teacher specialisation and the size of the gymnasium (Ruch, 2012) may all be contributing factors. Ultimately, PE in primary school is commonly delivered by general classroom teachers, however, research advises that PE specialists and staff training should be utilised (McKenzie, 2001; Nettlefold et al, 2011) and that teacher education may also be a cost-effective solution (Meyer et al, 2011) to help deliver and promote PA in PE. Research by Harris et al (2013) advocates that the level of MVPA attained during a scheduled PE class, can typically be achieved via effective planning and preparation as well as the efficient organisation and management of pupils and resources.

Break Time (morning recess) was scheduled for 15 minutes each school day which were comparable to the scheduled 15-25-minute recess utilised by both Verstraete et al (2006) and Nettlefold et al (2011). The mean time spent engaged in MVPA during break time was 2.8 ± 1.4 minutes. The girls recorded a lower mean time of 2.5 ± 1.4 minutes, while the boys recorded a higher mean time of 3.3 ± 1.5 minutes of their time in MVPA during break time. These results are lower in comparison to the findings of Nettlefold et al (2011) which reported that girls achieved 3.8 ± 3.3 minutes and boys achieved 5.3 ± 4.3 minutes of MVPA during morning recess. Moreover, research by Stratton and Mullan (2006) advises that children should participate in at least 50% MVPA during recess on a daily basis. The findings from this study specify that children spent 18.7% of morning recess

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in MVPA. While, the boys reported a higher percentage of 21.8% compared to the girls (16.7%) engaged in MVPA during morning recess. Which is similar to the 16% published by Wickle and Eisenmann (2007). However, these findings are lower than the 20-23% for girls and 28-32.9% for boys reported by both Nettlefold et al (2011) and Rigers et al (2005). Again, a number of factors may explain the low PA recorded during break time (morning recess) in this study. Research by Tucker and Gilliland (2007) and Duncan et al (2008) suggests that seasonality and weather has a substantial effect on children's PA and should therefore be considered when comparing PA across different periods and locations. This may also be the case for this study when comparing figures for NI to the UK (Rigers et al, 2005; Stratton and Mullan, 2005), Belgium (Verstraete et al, 2006), America (Wickle and Eisenmann (2007) and Canada (Nettlefold et al, 2011). The school(s) within this study provided children with games equipment, playground markings and adult supervision to encourage active play. However, PA is still relatively low compared to the findings from the studies highlighted above. Therefore, it may be necessary to implement strategies to increase activity on cold or rainy days (Duncan et al, 2008) or alternatively provide indoor opportunities during the cold and wet months to encourage regular PA year-round.

Lunch Time (lunch recess) was scheduled for 30 minutes each school day which was comparable to the scheduled 35-50-minute recess utilised by Nettlefold et al (2011). However, it was considerably shorter than the 80-90-minute lunch break employed within research by Verstraete et al (2006). The mean time spent engaged in MVPA during lunch time was 5.5 $\pm$ 3.1 minutes. The boys recorded a higher mean time of 6.2 $\pm$ 3.2 minutes, while the girls recorded a lower mean time 5.0 $\pm$ 3.0 minutes of their time in MVPA during PE. Again, these results are lower in comparison to the findings of Nettlefold et al (2011) which reported that girls achieved 12.5 $\pm$ 5.3 minutes and boys achieved 15.6 $\pm$ 7.5 minutes of MVPA during lunch time recess. The findings from this study indicate that children spent 18.4% of lunch recess in MVPA. While, the boys reported a higher percentage of 20.7% compared to the girls (16.8%) in MVPA during lunch time recess. These findings are almost identical to the percentages recorded during break time recess. Yet, these findings are again lower than the 30% for girls and 35% for boys reported by Nettlefold et al (2011). Whereas, research by Verstraete et al (2006) proposes that on average, boys and girls spent 44% and 42% of lunch time recess engaged in MVPA, respectively. As discussed, previously, seasonality and weather as well as equipment, facilities, playground markings and supervision may explain the variation in the findings of this study compared to others with regards to children's levels of PA during recess.

Despite, the fact that children accumulated an average of 37% of their daily recommended MVPA during recess, which is in line with previous studies (Ridgers, et al., 2006b) that recess may contribute up to 33% of daily-recommended MVPA. Overall, it would appear that, the PA intensities that children engaged in were low during both break time and lunchtime recess. Generally, children in these studies did not attain 50% of recess time in PA. It has therefore been proposed that a threshold of 40% is a more representative target (Rigers et al, 2005). Moreover, recent research advocates that providing additional games equipment as well as multicolour playground markings encourage active play. Verstraete et al (2006) found that after providing equipment, resulted in an increase in moderate and vigorous intensity activity during recess from 38% to 50% and 10 to 11% respectively. Similarly, Stratton and Mullan (2005) discovered that moderate and vigorous intensity activity increased from 36.7% to 50.3% and from 7.9 to 12.4% respectively when multicolour playground markings were introduced. Therefore, recess can and does provide an opportunity for children to engage in PA which may also lead to considerable contributions to daily recommendations as children tend to be less active away from the school setting (Ridgers et al, 2007). In comparison to school playtime, activity levels decline by 36.1% after school, 50.1% on Saturdays and 57.4% on Sundays (McGall et al, 2011).

Overall, the boys spent a higher percentage of the time in MVPA within scheduled PE classes, break time (morning recess) and lunch time (recess) compared to the girls in this study. These findings are comparable to those of preceding studies (Rigers et al, 2005; Verstraete et al, 2006; Meyer et al, 2011

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and Griffiths et al, 2013). Results indicate that there is no significant difference in the amount of time spent in MVPA ($P > 0.05$) on a PE day between the boys and girls in this study. Which is adequately supported by the work of Nettlefold et al (2011) which advises that boys and girls are equally inactive during PE and did not support the hypothesis that girls would engage in less MVPA and more LPA and SED activities compared with the boys. Interestingly, the levels MVPA accumulated by children within PE classes equated to around one third (6.4%) of the MVPA accumulated by children during both break time (18.7%) and lunch time (18.4%) respectively. Within this study, girls are typically less active than boys are during recess periods, similar to the findings of Verstraete et al (2006). Results would indicate that PE does not make a significant contribution to children's MVPA in this study, while MVPA during break and lunch time is a significant contributor to children's overall MVPA. Similarly, research by Ruch et al (2012) advises that MVPA accumulated during PE over the week only contributed to a fraction of the overall weekly MVPA. Nonetheless, the work by Meyer et al (2011) has reported that during PE days, 16.8% of the overall time spent in MVPA was accrued during PE lessons. Whereas, research by Ruch et al (2012) argues that by increasing the comparative amount of PA during PE lessons as well as increasing the PE lesson may also improve the contribution of PE to total daily PA. Despite the fact that schools can provide opportunities to engage in PA during PE classes, recess periods and extracurricular activities (Verstraete et al, 2006). Girls accumulated less MVPA and more SED than boys throughout the school day, break time and lunch time, comparable to research by Nettlefold et al (2011). Within this study all children failed to meet the recommended guidelines of 50% MVPA during PE, break and lunch times respectively. Research by Nettlefold et al (2011) suggests that original and innovative school-based PA models outside of structured PE that compliment but do not replace PE may be one effective solution to offset these negative findings. Additionally, Verstraete et al (2006) advises that schools should also maximize children's activity levels during PE classes and after school programmes. This may be achieved by providing game equipment over longer time periods (Verstraete et al, 2006) or providing access to suitable play areas in addition to high levels of adult supervision which are associated with higher levels of PA (Nettlefold et al, 2011). In closing, correlations between age, body composition and PA were inconclusive.

A key strength of this study is the use of accelerometers to objectively measured PA levels, however a limitation included a relatively small sample size. We would recommend that future research would benefit from a larger representative sample size as well as investigating the impact playground PA levels prior to school commencement and immediately following the end of the school day (i.e. 15 mins before and afterwards). We would also advise that participants PA being tracked across a year to cater for seasonal variety. Active travel and extracurricular activities could also be included and examined to provide a conclusive view of the impact of the school setting on children's PA. The preliminary evidence from this study could inform the development of strategies for further intervention studies and Public Health programs. Strategies and interventions may include, increasing the open hours of school playgrounds, pitches and sports facilities as well as providing staff training to facilitate the delivery and promotion PA within the school setting. When implemented. these proposed strategies and interventions should be monitored to quantify their impact on children's PA levels.

CONCLUSIONES

On average, children spent 63.3 ± 18.2 minutes in MVPA per day, with boys spending less time in SED and more time in PA than the girls. This study identified that 54.1% of children met the current PA guidelines of ≤ 60 minutes of MVPA per day, with 66.7% of boys and 45.9% of girls meeting the current daily MVPA guidelines. Results conclude that there was a significant difference ($P \leq 0.05$) between gender and the percentage of time spent in MVPA on a daily basis and on Non-PE days. However, there was no significant difference ($P \geq 0.05$) between gender and the percentage of time spent in MVPA on a PE day. Overall, the boys spent a higher percentage of the time in MVPA within scheduled PE classes, break time (morning recess) and lunchtime (recess) compared to the girls in this study. Results indicate that there is a significant difference ($P \leq 0.05$) between the mean ($\pm$SD) percentage spent in MVPA during PE classes compared to both break

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time and lunch time MVPA for both boys and girls. Within this study, children are more active at break time and lunch time than they are during scheduled PE classes. Which, suggests that PE does not make an important contribution to children's MVPA, while break and lunch time MVPA is significant contributor to children's PA within this study. However, PE and recess (break and lunch time) contributed to almost half (43.5%) of children's total MVPA, which would suggest that the school environment is a viable opportunity to help children meet the recommended PA guidelines and reduce SB.

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